PATENT SPECIFICATION

DRAWINGS ATTACHED

1,096,730

1,096,730

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Int. Cl.:—**H 05 b 1/00**

COMPLETE SPECIFICATION

Improvements in or relating to Irradiation Apparatus

I, LAZARUS BENJAMIN DE VRIES, a Dutch National, of Beethovenstraat 219, Amsterdam, Holland, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to irradiation apparatus and, more specifically, is concerned with apparatus for irradiating a body over the greater part of its entire surface area with a relatively uniform intensity of radiation. The invention is particularly, although not exclusively, useful in connection with domestic cooking apparatus where uniform grilling of a body with heat is required. The use of direct infra-red heating for frying is, of course, well known, and apparatus of the invention is particularly useful for applying infra-red heat to a body to be grilled.

Irradiating apparatus, in accordance with the present invention, comprises an enclosure shaped as a symmetrical body of revolution and internally providing annular reflective bands encircling the axis of revolution and so positioned in relation to one another that a body mounted centrally in the enclosure has the bulk of its surface area irradiated relatively evenly by radiation reflected towards it from the bands and emanating from an annular irradiation source disposed adjacent to the inside surface of the enclosure and shielded from the centre thereof by a reflecting shield which lies with the source in a plane of symmetry extending through the enclosure perpendicularly to said axis. The reflecting shield preferably is of chevron cross-section and the two arms of the chevron may be bowed inwardly a small amount.

Preferably the enclosure is formed in two halves which fit together along a division line lying substantially in the plane of symmetry. The two halves conveniently comprise upper and lower halves to the enclosure; and the source, which may be a heat radiating tube, is suitably mounted with the shield preferably in the lower half of the enclosure which may be rested on a suitable base. The body to be heated is conveniently carried by a frame which spans across the centre of the lower half of the enclosure beneath the plane of symmetry. The frame may be in the form of a sinuous wire and, in the preferred arrangement, opposite ends of the wire are carried in slots formed in plates which are carried by arms fitting at diametrically opposite positions against the wall of the lower half of the enclosure. The plates may be provided with vertically spaced slots to enable the vertical position of the frame in the container to be adjusted by selecting different slots.

The invention will now be described in more detail, by way of example, with reference to the accompanying drawings, in which:—

FIGURE 1 shows an enclosure in side elevation;

FIGURE 2 is a perspective view of the bottom half of the enclosure and a base on which it rests;

FIGURE 3 is a perspective view of the top half of the enclosure and a lid;

FIGURE 4 shows in side elevation the method of mounting parts within the enclosure;

FIGURE 5 shows in plan part of a sinuous frame used for supporting a body inside the enclosure;

FIGURE 6 is a diagrammatic section through half of one side of the enclosure and shows part of the radiation heat path between a source of heat and a body to be heated;

FIGURE 7 corresponds to Figure 6 and shows most of the remainder of the radiation heat path;

FIGURE 8 shows yet another shape of enclosure usable for carrying out the invention; and,

FIGURES 9, 10 and 11 are respectively side, end and plan views of an alternative arrangement to that shown in Figure 4 for mounting parts within the enclosure.

Figure 1 is a domestic cooking enclosure 1 for heating an article such as a chicken. The enclosure is shaped as a body of revolution about a vertical axis and is symmetrical about a horizontal plane 9 passing through the centre of the enclosure. The enclosure 1 is formed by a top half 2 having its lower edge resting in the plane of symmetry on the upper edge of the bottom half 3 which rests at its underside on a metal framework base 4. The adjacent rim portions of the top and bottom halves of the enclosure are outwardly dished in the region of the plane of symmetry 9 to provide the enclosure with an encircling outwardly projecting bead 5 of concave cross section. The top and bottom halves 2, 3 of the enclosure are each formed with a central aperture shown more clearly at 200 and 12 in Figures 3 and 2, the top aperture 200 being closed by a lid 6 and the bottom aperture 12 having disposed beneath it a shallow dish 17 which rests in the centre portion of the base 4 in order to collect drips from the bottom pole of the enclosure. The lid 6 and dish 17 are vented at 29 to permit ventilation through the enclosure.

The enclosure 1 is made of metal, suitably stainless steel, and its inside surface is preferably polished to make it highly reflecting. It will be observed from the Figures that the reflecting surfaces of the top and bottom halves of the enclosure form annular reflective bands which encircle the upright axis passing through the centre of the enclosure.

The source of heat for the enclosure is provided by an annular tube 14 containing an electrical heating element and disposed adjacent the inside surface of the bead 5 of the enclosure. Opposite ends of the annular tube are twisted across one another to ensure a more uniform heat radiation pattern and pass into a socket 7 to which a plug and connected to one end of an electrical lead can be fitted. A reflecting shield 13 is mounted radially inwardly of the tube 14 and is of chevron cross-section having the limbs of the chevron slightly bowed inwardly. The shield 13 presents a polished convex surface facing the tube and serves the dual function of preventing heat radiated by the tube from falling directly onto an article placed in the centre of the enclosure and reflecting such radiated heat towards the sidewalls of the enclosure. The article to be heated is mounted on a sinuous frame 15 spanning diametrically across the enclosure.

The method of mounting the tubular heat source 14, shield 13 and frame 15 will be understood from referring jointly to Figures 2, 4 and 5. Referring to Figures 2 and 4 two fixtures 10 are disposed at diametrically opposite positions of the lower half of the enclosure and are made of stiff wire. Each fixture comprises essentially a wire bent into a cranked U-shape providing with its parallel sides two upright arms which stand against the wall of the bottom half and have their cranked lower tips passing through holes 20 in the underside of the bottom half 3 adjacent the framework base 4. As shown in Figure 4 the upright side arms of the fixture terminate at their upper ends in angled portions 19 which projects into the bead 5 formed at the junction of the top half 2 and bottom half 3. A tongue 21 formed by a return bend in the wire passes through a small incision 22 formed in the bead 5 as shown in Figure 1. Above the angled portion 19 the wire extends upwardly a short distance inside the marginal lower portion of the top half 2 of the enclosure and then projects radially inwardly at 23 towards the centre of the enclosure to terminate in an upwardly directed hook portion 24. Hooked onto the hook portion 24 is an upright metal bracket 25 having three side slots 26 extending a short distance horizontally inwards from opposite edges of the bracket 25. The upper and lower portions of the bracket 25 are provided with a pair of shoulders 27, 28 between which is sprung the circular shield 13. Figure 4 shows the shield 13 in cross-section from which its general chevron shape is clearly apparent. Although the arms of the chevron provide the shield with slightly curved reflecting surfaces 30, 31 which converge towards one another and the plane of symmetry of the enclosure the arms may equally well be straight or complexly curved. The two reflecting surfaces 30, 31 together are wide enough to shield the body in the centre of the enclosure from direct heat emanating from the heater tube 14.

The angled portion 19 of the wire disposed in the bead 5 carries a metal plate 34 by means of tabs 35 which are hooked over the wire. The metal plates 34 are provided with registering cut outs 36 in which seats the heater tube 14. The frame 15 on which the article to be heated rests is shown in Figure 5 and comprises a sinuous wire 37 having pins 38 which locate in one of the three slots 26 provided in bracket 25. By selecting different pairs of slots the vertical positioning of the frame 15 in the enclosure may be altered.

Turning now to Figure 6 it will be seen that the top and bottom halves of the enclosure are symmetrical about the plane of

symmetry 9 in which the tubular heater 14 and the shield 13 lie. The bottom half 3 of the enclosure will now be described and it will be understood that the top half 2 is the mirror image of it and corresponding parts are denoted by primed references.

The bottom half 3 of the enclosure comprises a frusto-conical base portion 40 which tapers very gently downwards towards a downturned lip 41 surrounding the circular opening 12 in the bottom of the base. The outside rim of the base portion 40 is joined by a circular angle portion 44 having a vertical limb 45 and a downwardly sloping limb 46. The contained angle (β) between the limbs 45 and 46 is slightly greater than 90° and the contained angle (ψ) between the downwardly sloping limb 46 and the radial line of the frusto-conical base 40 is slightly less than 180°. The vertical limb 45 of the angular portion merges with the sidewall 47 of the enclosure which flares outwardly and upwardly towards the underside of the bead 5.

The top half of Figure 6 shows the path followed by heat radiated upwardly from the heater 14. It will be seen that the path may be considered as comprising two parts, the first part comprising heat radiated through the solid angle L and the second part comprising the heat radiated through the solid angle F. It will be seen that the heat radiated through the solid angle L is incident on the sloping upright sidewall 47′ of the enclosure and is reflected by it onto the gently sloping frusto-conical top portion 40′ of the enclosure and limb 46′. From the top portion and limb 46′ it is reflected downwardly substantially uniformly over the central portion of the enclosure. Likewise, the small portion of heat reflected directly from the inclined limb 46′ of the upper angular portion 44′ is reflected towards the central portion of the enclosure. Finally, it will be seen that heat directed towards the upper frusto-conical portion 40′ is also reflected downwardly substantially evenly over the central portion of the enclosure.

It is to be observed that substantially all the radiated heat in Figure 6 is incident on the top portion 40′ outwardly of the lip 41′ and is reflected towards the space limited by the reflecting shield 13 the edge of which intercepts heat directed towards the central apertures 12 and 200. Thus an article placed in the central portion of the enclosure is heated from above and beneath substantially uniformly by reflected heat.

During use, liquid may ooze from the article and this drips onto the bottom of the enclosure and flows downwardly towards the central opening 12 and from there into the dish 17 disposed beneath the central opening. By removing the cover or lid 6 the extent to which the article is grilled may be observed without loss of directly radiated heat.

It will be appreciated from Figure 2 that all of the parts making up the enclosure are readily detachable from one another for cleaning and, as a result of the simplicity of the parts, cleaning is made relatively easy.

Figure 7 shows the paths followed by heat radiated towards the concave surfaces of the bead 5 and the convex surfaces of the reflecting shield 13. It will be seen that heat incident on the upper inside surface of the bead 5 is reflected downwardly and is incident on the frusto-conical portion 40 of the base but does not reach the bottom opening 12. This heat is reflected upwardly by the frusto-conical portion substantially evenly over the central zone of the enclosure. Likewise, heat radiated towards the upper inclined surface of the shield 13 is reflected by it into the region of the angular portion 44′ at the top corner of the upper half 2 of the enclosure and is reflected from there downwards while part is reflected onto the frusto-conical top portion 40′ of the enclosure and then downwardly towards the central portion of the enclosure.

Figure 8 is a vertical section through an alternative shape of enclosure particularly well suited to cooking poultry. Only essential details are shown from which it will be seen that the enclosure comprises a top portion 100 resting at its lower edge which lies in a horizontal plane of symmetry 120, on the upper edge of a bottom portion 101 which is the mirror image of the top portion. An outwardly projecting hollow bead 105 is formed between dished rims on the top and bottom portions of the enclosure and projects horizontally outwards around it. The bead seats on a wire stand 106 which provides a pedestal for the enclosure and is formed with legs one of which is shown in section. Mounted inside the bead is a circular tubular heater 102 which is shielded from the central portion of the enclosure by a reflecting shield 108 carried by a number of arms 109 mounted inside the bead 105.

In Figure 8 the number of annular reflecting bands encircling the axis of revolution is greater than in the embodiment described above and it is therefore not so easy to manufacture. However it has the advantage that a bulbous article to be heated, such as a chicken, when mounted in the centre of the enclosure is more evenly heated as some of the heat is reflected between different bands two or more times before striking the article. The angles between the bands and their co-operation with the reflecting inside and outside surfaces of the shield 108 are such that reflected heat is incident on substantially all portions of the bulbous article from a multiplicity of different angles. This ensures that the sides of the article are evenly heated to

cooking temperature as well as the top and bottom surfaces of it.

Figures 9 to 11 show an alternative form of support fixture. Referring to Figure 9 the support fixture comprises a pair of parallel spaced metal plates, one of which is shown at 70. The plate 70 extends inwardly of the enclosure and is provided with an upright ear 71 having a root portion 72 which passes through upright aligned incisions 73 formed in the top and bottom halves 74, 75 of the enclosure at a bead 76 where they fit together. The two halves 74, 75 of the enclosure may be of the shape shown in either of the embodiments described above.

The plate 70 has a part 77 shaped to rest snugly against the lower half of the bead, and a part 78 which is of Z-shape extending forwardly into the enclosure and terminating in an upwardly directed shoulder 79. Held at its lower edge in a slot behind the shoulder 79 is a reflecting shield 80 similar to shield 13 described in Figure 2. The front portion of the shoulder 79 is provided with an upwardly opening slot in which seats the lower edge portion of a carrier plate 81 shown in face view in Figure 10. The plate is rectangular and provided at each side with three side slits 82 each opening into a well 83 for the reception of one end 38 of a sinuous wire frame such as that shown at 37 in Figure 5.

The horizontal division line between the two halves 74, 75 is referenced 84 and it will be apparent from Figure 9 that it passes through the centre of the shield 80 and the carrier plate 81. The support plate 70 also has resting upon it a circular heat-radiating element 85 similar to the tube 14 shown in earlier figures. The element 85 is held in a rebate formed between the top limb of the part 78 and a bracket plate 86 held against the support plate 70 and formed with two tongues 88 which pass through upright slots 89 in the plate 70 as shown in Figure 11. The lower portion of the bracket plate 86 is formed with a right angle flange 87 which is held against the side wall of the bottom half 75 of the enclosure by means of a nut and bolt 90.

The support fixture shown in Figures 9 to 11 is sturdy and is made of stainless steel so that it is easier to clean than wire. It is also readily dismantled for cleaning as all that is necessary is to undo the nut and bolt and lift the complete support fixture from the bottom half of the enclosure. The bracket plate 86, heating element 85 and support plate 70 are then separable from one another by sliding the support plate 70 along the tongues 88.

WHAT I CLAIM IS:—

1. Irradiation apparatus comprising an enclosure generally shaped as a symmetrical body of revolution and internally providing annular reflective bands encircling the axis of revolution and so positioned in relation to one another that a body mounted centrally in the enclosure has the bulk of its surface area irradiated relatively evenly by radiation reflected towards it from the bands and emanating from an annular radiation source disposed adjacent the inside surface of the enclosure and shielded from the centre thereof by a reflecting shield which lies with the source, in a plane of symmetry extending through the enclosure perpendicularly to said axis.

2. Apparatus as claimed in claim 1, in which the enclosure is formed in two halves separable along a division line lying substantially in the plane of symmetry.

3. Apparatus as claimed in claim 1 or claim 2, in which the source lies between a concave annular portion of the enclosure and diverging reflecting surfaces of the shield.

4. Apparatus as claimed in claim 3, in which the concave annular portion of the enclosure is formed by two annular reflecting bands of curved cross-section meeting on the plane of symmetry, and the shield is of chevron cross-section and comprises two annular reflectors meeting on the plane of symmetry.

5. Apparatus as claimed in any one of the preceding claims, in which adjacent bands on the same side of the plane of symmetry make an angle with one another greater than 90° when viewed in cross-section.

6. Apparatus as claimed in any one of the preceding claims, in which the axis of revolution of the enclosure is upright.

7. Apparatus as claimed in any one of the preceding claims, in which the enclosure is made of stainless steel and the reflecting bands are polished areas on the inside surface of the enclosure.

8. Apparatus as claimed in claim 2 or any one of claims 3 to 7 when dependent thereon, in which the lower half of the container rests on a stand, and the shield and source are carried by removable fixtures mounted on the lower half of the enclosure.

9. Apparatus as claimed in claim 8, in which a frame for supporting the body to be irradiated spans across the centre of the enclosure and is carried at its ends in a bracket which also supports the shield and is carried by the fixtures, the connection between the frame and the bracket being adapted to enable the frame to be mounted in different vertically spaced positions inside the enclosure.

10. Apparatus as claimed in claim 8 or claim 9, in which the source comprises a heat radiating tube having its opposite end-portions twisted to pass out of the enclosure directly above one another so that the source makes one complete convolution inside the enclosure.

11. Apparatus as claimed in any one of the preceding claims, in which the enclosure has a base portion of gently downwardly tapering frusto-conical shape and surrounding a central aperture, an angle portion disposed between the rim of the base portion and a circular sidewall of the container, the angle portion having a contained angle of marginally greater than 90° and having one limb upright and the other limb sloping downwardly towards the periphery of the base at an angle to the horizontal slightly greater than the angle made by the radial line of the base portion with the horizontal, and the sidewall of the container slopes outwardly and upwardly away from the upright limb of the angle portion and terminates in an outwardly convex surface surrounding the lower half of the source.

12. Apparatus as claimed in any one of the preceding claims, in which the enclosure comprises two identical halves fitting together along the plane of symmetry and having central apertures, the bands being positioned to minimise the reflection of heat towards the apertures and vented covers being provided for the apertures to ventilate the interior of the enclosure while preventing the radiation of heat therefrom, the bottom cover also serving as a drip catcher for the bottom half of the container.

13. Irradiation apparatus arranged and adapted to operate substantially as described with reference to Figures 1 to 7 of the accompanying drawings.

14. Apparatus as claimed in claim 12, but modified substantially as described with reference to Figure 8 of the accompanying drawings.

15. Apparatus as claimed in claim 13 or claim 14, modified by the provision of support fixtures substantially as described with reference to Figures 9 to 11 of the accompanying drawings.

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Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained

FIG.1.

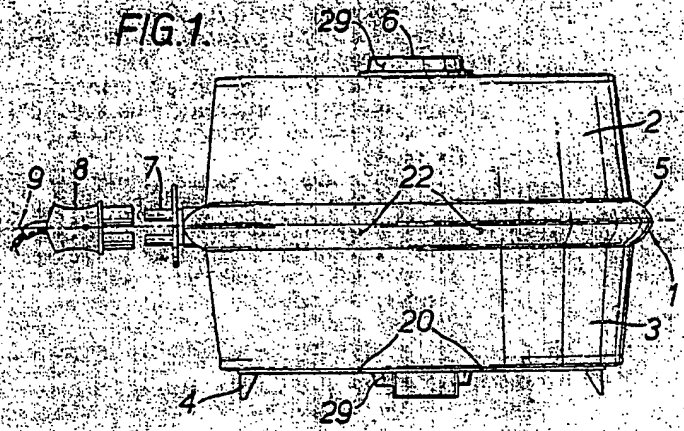

FIG.2.

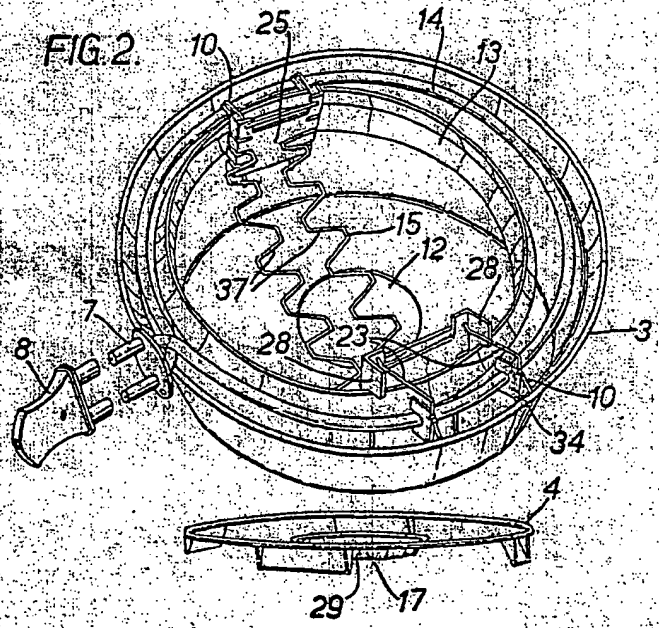

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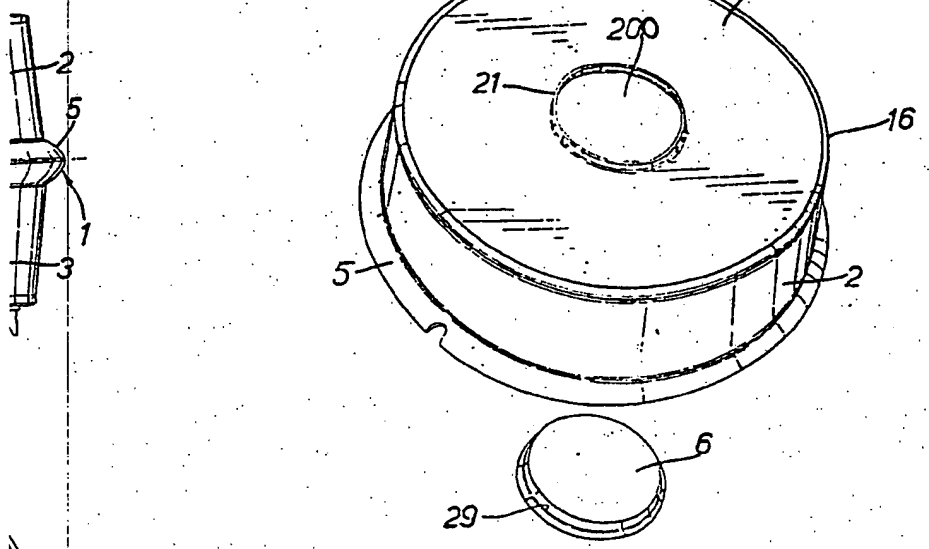
FIG.3.



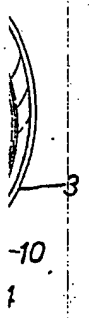


FIG.4.

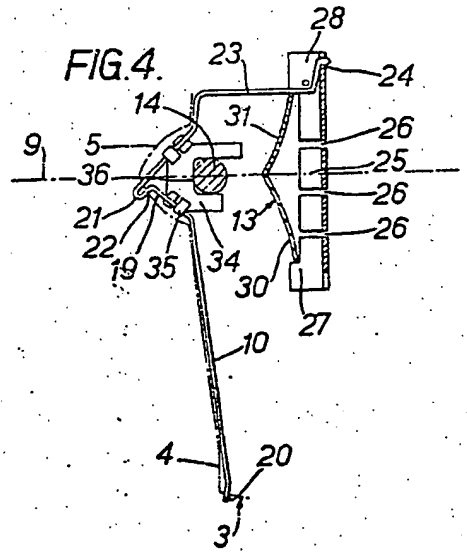


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FIG.1

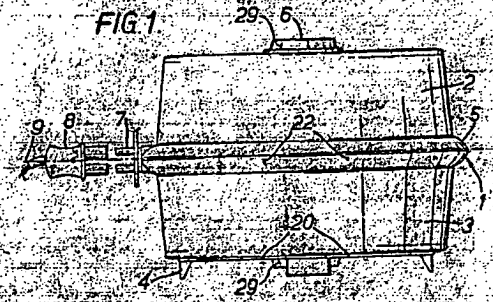

FIG.2

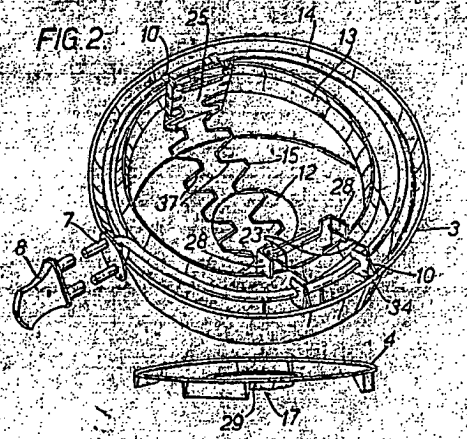

FIG.3

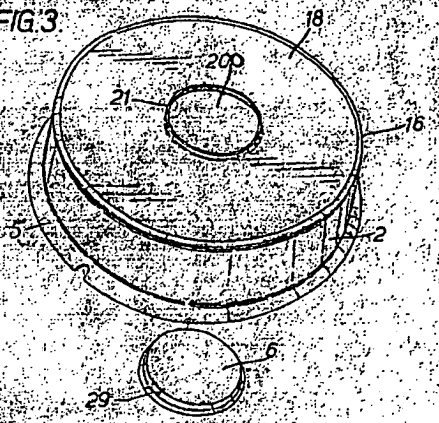

FIG.4

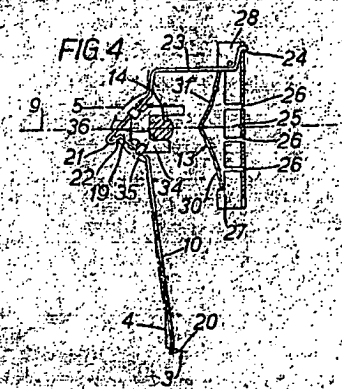

FIG. 5.

FIG. 6.

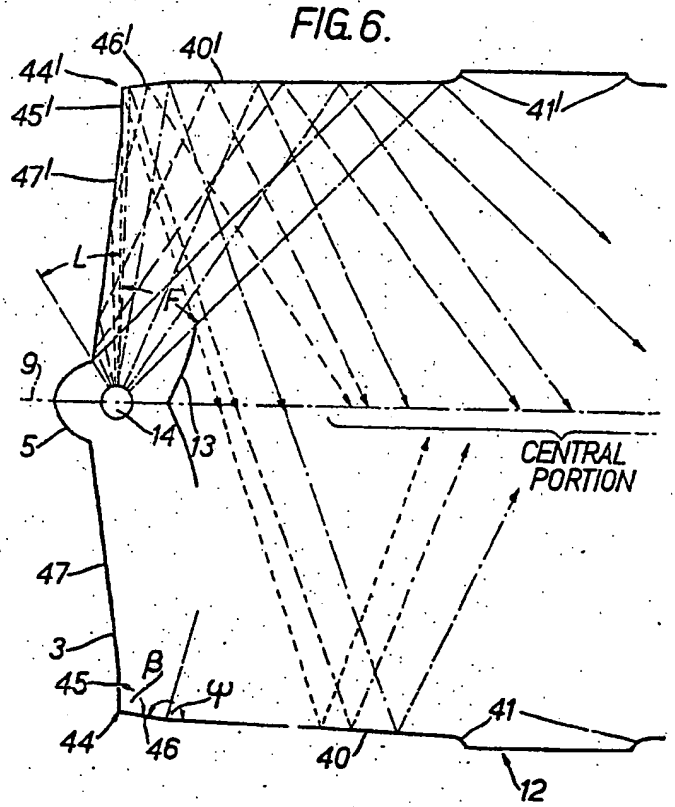

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FIG 7

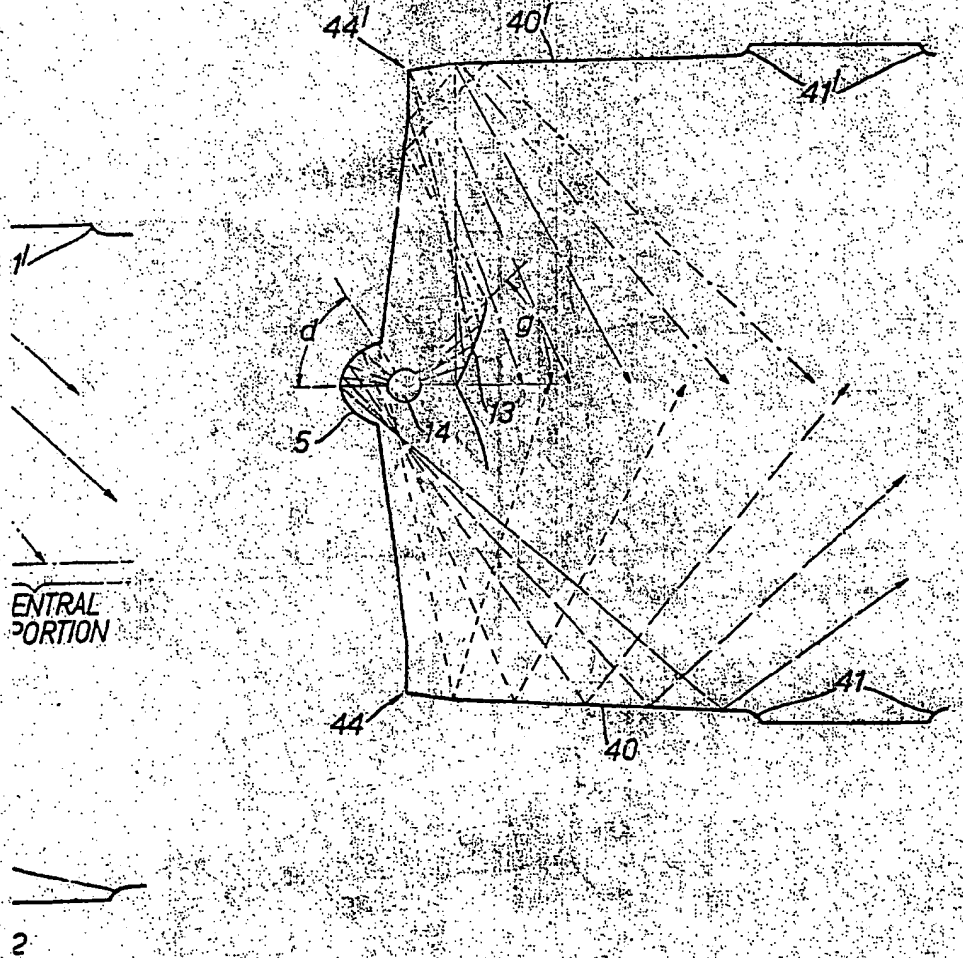

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FIG.5.

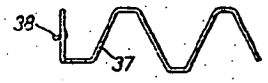

FIG.6.

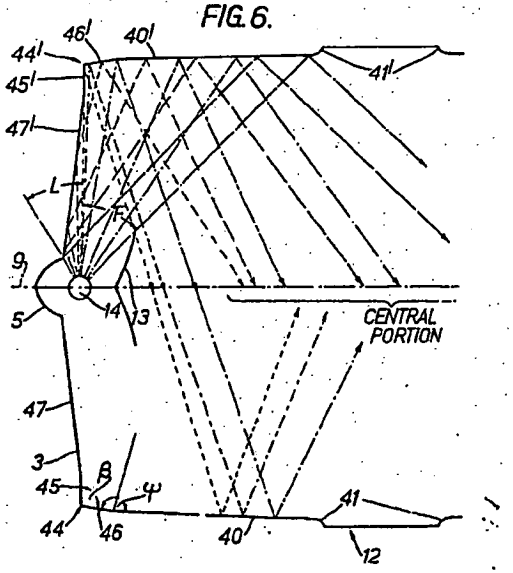

FIG.7.

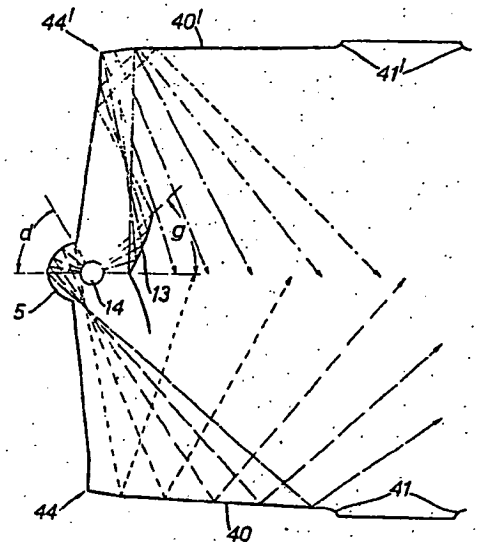

FIG. 8

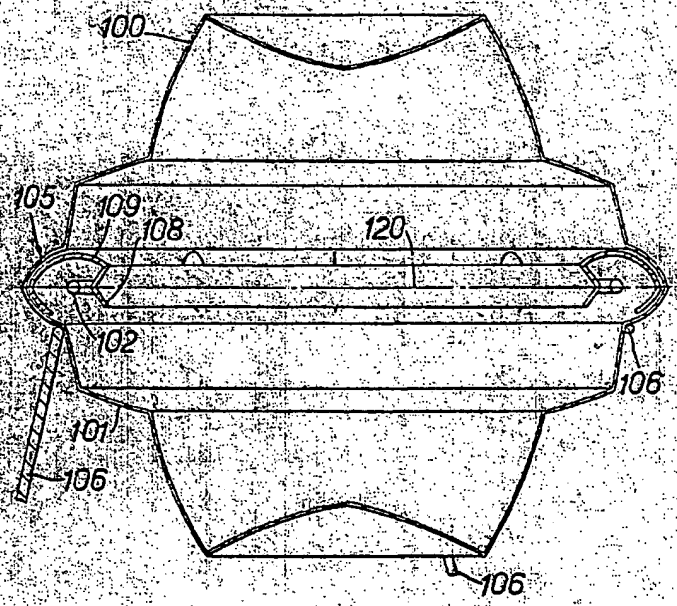

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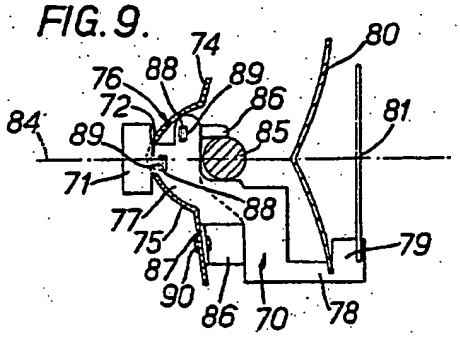
FIG. 9.



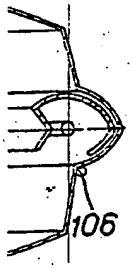


FIG. 10.

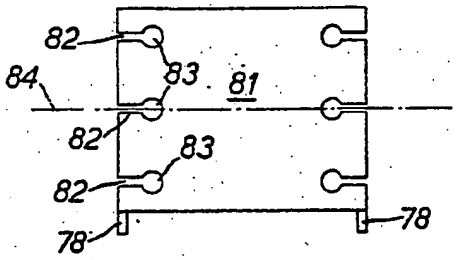


FIG. 11.

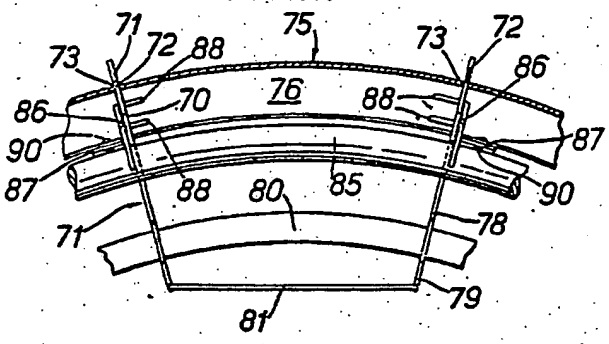


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FIG. 8.

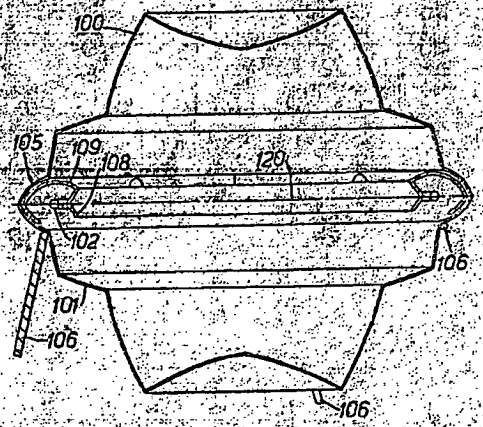

FIG. 9.

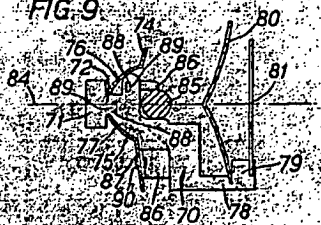

FIG. 10.

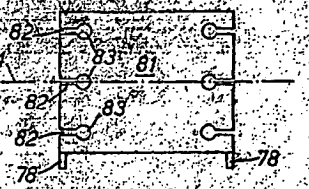

FIG. 11.